Integrated Control Technique of Poplar Diseases in China[1]

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Abstract The main disease species on poplar are introduced in this paper. The main content of the integrated control technique on poplar diseases is summarized: (1) Forecast technique based on the initial disease and provention factors. (2) Control index is established, based on the relationship among the disease index, height of tree, diameter grade and the loss rate of volume. (3) Five fine varieties are selected according to three integrated indexes of host, such as resistance, volume growth and form ratio: They are 613 (*Poulus alba* × *P. berolinensis*), A15 (*P. xiaohei* × *P. euramericana* CV. Polska-15A), A98 (*P. xiaohei* × (*P. simonii* × *P. nigra*) CV. A98), A102 (*P. xiaohei*) × (*P. simonee* × *P. nigra*) CV. A102), L2 (*P. simonii* × *P. nigra* var. *italica*) in northeast Chnia. (4) Sivicultural control is known as the main protection measures, combined with chemical control and biocontrol, based on the disease forecast and control index by tracing the whole process of forest production.
Key words: Poplar; Disease; Integrated control technique

Introduction

Now the reserved area of artificial forests is 3.3333×10^7 hm^2 in China, while the area of Poplar is 6.6×10^6 hm^2. It makes China become the largest country in possessing artificial forests of Poplar. Poplar varieties and number increase gradually with artificial forests of poplar rapid developing. In the past, poplar diseases and insect pests spread rampantly because of the bad site conditions, incorrect varieties selection, extensive management. According to incomplete statistics, there were more than 200 kinds of pathogen to be harm to poplars in the world, while there were 113 kinds of fungi pathogen, 2 kinds of bacterial pathogen, 1 kind of virus, 1 kind of nematode, 2 kinds of mite, 6 kinds of parasitic seed plant, 5 kinds of uninvaded pathogen in China. Systematic studies have been carried out on many poplar diseases. In this paper the several main kinds of poplar diseases are researched, such as gathay poplar leaf rust (*Melampsora larici-populina* Kleb.), davids European aspen leaf rust (*Melampsora laricis* Hart.), *Marssonina* black spot of poplar (*Marssonina brunnea* (Ell. et Ev.) Sacc., M.populi (Lib.) Magner), *Coryneum* grey spot of poplar (*Coryneum populinum* Bresad. teleomorphic: *Mycosphaerella mandshurica* Miura), *Fusicladium* black stra of poplar (*Fusicladium tremulae* (Fr.) Adeth. teleomophic: *Venturia tremulae* (Frank.) Aderh.), *Alternaria* leaf blight of poplar (*Alternaria alternata* (Fr.) Keissler), *Valsa* canker of poplar (*Valsa sordida* Nit. anamorphic: *Cytospora chrysosperma* (Pers.) Fr.), *Botryosphaeria* canker of poplar (*Botryosphaeria dothidea* (Moug ex Fr.) Ces. et de Not.=*B.ribis* (Tode) Grossenb et Duggar anamorphic: *Dothiorella gregaria* Sacc.), *Dothichiza* canker of poplar (*Dothiciza populea* Sacc. et Br.= *Chondroplea populea* (Sacc.) Kleb. telemorphic: *Cryptodiaporthe populea* (Sacc.) Butin = *Cenangium populineum* (Pers.) Rehm), *Botryodiplodia* canker of poplar (*Botryodiplodia populea* Z.K. Zhon), *Coryneum* swollen sten canker of poplar (*Coryenum populinum* Bresad. teleomorphic: *Mycosphaerella mandshurica* Miura), *Erwinia* canker of poplar (*Erwinia herbicola* (Lohnis) Dye), et al. According to the modern forestry pathology and viewpoints of ecology and economics, we put forward a set of integrated management technique of controlling poplar disease.

Results

Prediction technique

The fixed standard plots and standard trees were established on the basis of different varieties, ages, stands. Disease periods, amounts, epidemology and environmental factors are observed and investigated every year. The local history data on disease are anylisised. We put forward the prediction models by using mathematical statistics, in order to fine the correlation among disease

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growth and decline and the meteorological factors.

Prediction model of *Coryneum* canker of poplar:

$y=2.20-0.0034X_3+0.0000088X_3^2$

Where,

y : the prediction objective--the primary disease index;

X_3 : the pathogen base according to the disease index in early July and rainfall in May.

Prediction model of *Marssonina* black spot of poplar:

$y=77.838+3.975X_1-0.856X_2-0.284X_3$
$+0.774X_4-306.077X_5+0.000222X_6$

Where,

y : the prediction objective--the disease index after ten days

X_1 : the temperature;

X_2 : the humidity;

X_3 : the rainfall;

X_4 : the ratio of X_1 to X_2;

X_5 : the primary disease index;

X_6 : the ratio of X_2 to X_3.

Prediction model of *Valsa* canker of poplar:

$y=14.957++0.208X_1-0.198X_2+0.002X_3$
$+0.910X_4-0.152X_6$

Whrer,

y : the prediction objective--the disease index after 30d;.

X_1 : the temperature;

X_2 : the humidity;

X_3 : the rainfall;

X_4 : primary disease index;

X_5 : the ratio of X_1 to X_2;

X_6 : the ratio of X_2 to X_3.

Prediction model of *Botryosphaeria* canker of poplar:

$\ln[X_2/(1-X_2)]=0.593820+0.00717T+0.007470V$
$+0.000420R+1.065010\ \ln[X_1/(1-X_n)]$

Where,

T : the average temperature of last month;

V : the average humidity of last month;

R : the rainfall of last month;

X_1 : the primary disease index of last month;

X_2 : the disease index after a month.

Prediction model of *Coryneum* canker of poplar:

$y=-100.468-2.089X_1+1.023X_2-0.076X_3$
$+0.928X_4+324.968X_5+2.755X_6$

Where,

y : the prediction objective--the disease index after 30d;

X_1 : the average temperature;

X_2 : the average humidity;

X_3 : the rainfall;

X_4 : the primary disease index;

X_5 : the ratio of X_1 to X_2;

X_6 : the ratio of X_2 to X_3.

Prediction model of *Erwinia* cankerof poplar:

$y=-0.16347+0.7969y_0+8.63864t/r$

Where,

y : the prediction objective--the disease index of this year;

t/r : the ratio of temperature humidity;

y_0 : the primary disease index.

Disease loss and control index

After establishing model of prediction disease, the loss model was established, then the economic threshold and the control index were determined on the basis of the relationship between the disease and the loss of production.

The control index of *Marssonina* leaf spot of poplar, *Coryneum* grey of poplar and *Coryneum* swollen sten canker of poplar: losses of different disease index for cutting are estimated according to the diameter grades, and quantity of cuttings of different disease grade, and diameter for roots. The losses of different disease index for saplings reserved are determined according to loss stands for grades of sampling height. On the basis of the losses of saplings, the economic threshold for saplings from cuttings is disease index 16 and the control index is 17 and the economic threshold for saplings reserved is disease index 18 and the control index is 19.

The control index of *Valsa* and *Botryosphaeria* and *Erwinia* canker: in different poplar stand, the method of uniform distribution, typical population sampling and stem analysis was used in field. Bsed on the relationship among the height, diameter grade, volume losses and the disease index, the model of disease loss is conducted. The models of economic threshold and relative control index, the economic threshold and relative control index were determined.

The prediction index calculating model of *Valsa* canker of poplar:

$$X_{ET}=\left[\frac{-\ln\left(1-\sqrt[1.3516]{\frac{1.6722W}{0.0201}}\right)M\cdot R}{0.0201}\right]\cdot Q$$

The prediction index calculating model of *Erwinia* canker of poplar:

$$X_{ET}=\left[\frac{-\ln(58.1650P.V-100W)}{1261.33}/0.0620-M.R\right]\cdot Q$$

Where,

X_{ET} : the control index based on the disease index;

W : the control cost;

P : the price of each material;

V : the expected volume;

M : the time needed to control the disease;
R : the developing speed of the disease;
Q : the control effect.

Selecting the fine varieties against disease

Cultivating fine varieties is a basic way of controlling poplar disease. The difference of disease-resistance among different poplar varieties or hybrids existed commonly. A kind of pathogen can only do harm to one or few kinds of poplar, but can't do harm to other kinds. It was verified that *Melampsora magnusiana* can only do harm to some varieties of white poplar, especially *populus tomentosa* Carr.. On the contrary, *Melampsora larici-populina* can do harm to other varieties except *Populus tomentosa* Carr.. So we can select fine varieties by using the difference of disease-resistance of different varieties.

In China, it is in order that the fine varieties are selected. The experiments are conducted, such as artificial inoculation, induced trial, regional experiment. The resistance of diseases was determined for different poplar varieties, resources, single tree against diseases. The resistant rank to *Valsa* canker and *Botryosphaeria* canker is determined. In northeast China, 5 fine varieties against diseases were selected, which were 613 (*Poulus alba* × *P. berolinensis*), A15 (*P. xiaohei* × *P. euramericana* CV. Polska-15A), A98 (*P. xiaohei* × (*P. simonii* × *P. nigra*) CV. A98), A102 (*P. xiaohei*) × (*P. simonee* × *P. nigra*) CV. A102) , L2 (*P. simonii* × *P. nigra* var. *italica*); In Hua Bei province region, 3 fine varieties against diseases were selected, which were Middle forest 115, 379, 34. At the same time, a set of index was determined, such as bark turgidity of the host (RT-value), antibiotic substance, physiological and biochemical index and POD. The RT. threshold value is also determined as 75% when valsa canker and *Botryosphaeria* canker may occur.

If the catechol concentration in the poplar varieties is high, the poplar will have resistance of the disease. On the basis of it, the index of selection, utilization and evaluation the resistant varieties was put forward: infection degree, anti-decease, growth volume and form ratio; bark furgidity of the host (Rt-value) the concentration of K. Mn. Catechol. These achievements have some guiding effects on production, but they can't meet the need of production far away. The research should be conducted in using routine breeding as well as biological technology.

Silvicultural measures

The silvicutural measures are to adjust the ecological environment, produce the beneficial condition to the growth of forests, increase the disease resistance of post population, restrict the growth, multiplication and spreads of disease. So it became the main part of the integrated control of poplar disease. The main silvicultural measures include 8 aspects, which were selecting fine resistant varieties, foeced seedling strong, prefered condition to plant seeding, truncated trunk to save water, cultivation, grass stripping, pruning, intermediate cutting.

Chemical control

It is necessary urgent measure to use fungicides for controlling poplar disease. On the basis of screening of fungicides in experiment room or field. Three systematic germicides were selected, such as Topsin-M, Bavistin. C. C. M. A.

Biocontrol

In recent years, the achievements of biocontrol on poplar disease have been gotten. *Trichoderma* sp. from antagonism was isolated and determined, its sporopollen and fermented liquid have great control effects on *Valsa* canker and *Botryosphaeria* canker; Moreover, *Coriolus versicolor. Cerrena unicolor* were isolated and determined from poplar stumps. The stumps are inoculated, then they can decay rapidly. So slash afforestation can be carried out in experiment land and *Armillariella tabescens* can be controlled too.

The results show that the biocontrol is a hopeful new way on the basis of these achievements.

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